Influence of ESP® – "Electronic Stability Program“ – on Road Safety

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Introduction

Many people feel that their individual mobility is directly linked to owning a private car. Studies indicate that practically all regions of the world show an unmistakable correlation between the gross domestic product and mobility. It is thus safe to assume that with increasing economic wealth, individual mobility is also further increasing with all the known consequences as regards to consumption, emissions and road safety.

Europe's great wealth resulted in a vehicle fleet of 261 million vehicles in 2003. In the same year, the number of accidents with bodily injuries registered amounted to 1.3 million and a total of 44,100 fatalities were counted. Over the same period of time, more than 104,000 people were killed in some 500,000 accidents in China, which has a vehicle population of a mere 22.2 million cars. Aside from differences in the infrastructure and personal habits, this is mainly due to the different equipment of the vehicles when it comes to passive and active safety systems.

The number of people killed in road accidents has been declining for years in Europe, despite a simultaneous increase of the mobility rate. One reason is the better equipment of vehicles with greatly improved passive safety in the structure and passenger cell as well as the use of seat belts, head rests and airbags. Improvements in passive safety are sure to continue, however, major progress was achieved in the active safety systems when ESP® was launched in 1995. In the following, we are going to describe the action of the "Electronic Stability Program" ESP® and the positive effect on driving safety in greater detail.

Mode of Action of ESP®

The ESP® system receives the required information of the driver's intentions regarding steering and braking and thus on the vehicle's intended course through the steering and brake pressure sensors (see fig. 1).

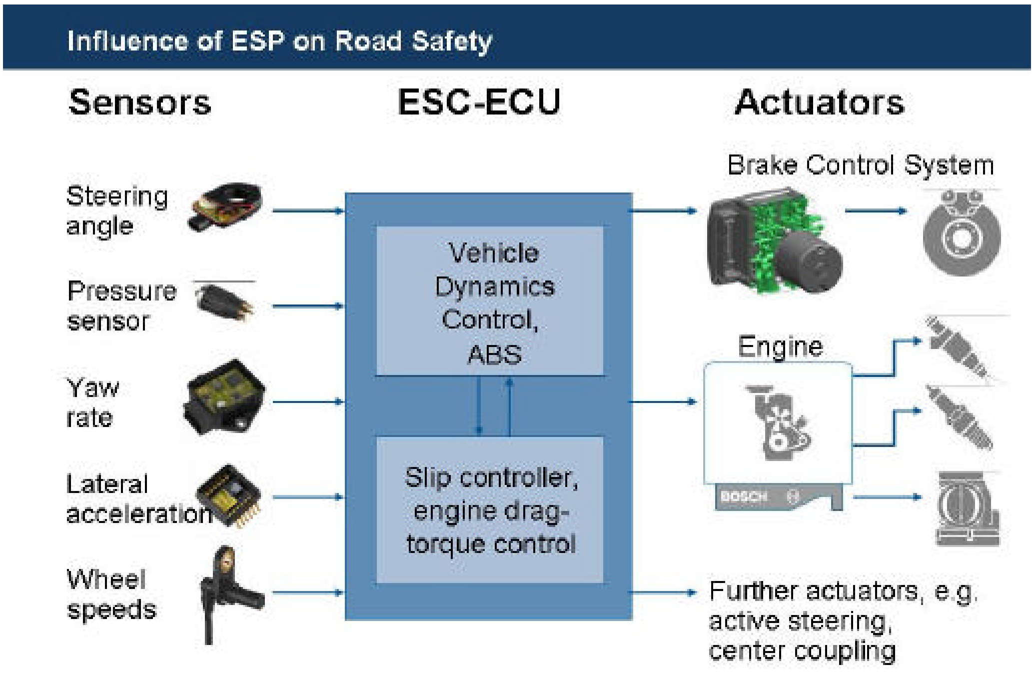


Fig.1: Components of the ESP® system and triggered units.

The wheel speed sensors determine the current speed driven by the vehicle. The turning movement of the vehicle around the vehicle vertical axis and the resulting lateral acceleration are measured by the lateral acceleration and yaw rate sensors. ESP® becomes active whenever the course of the vehicle determined by this information deviates beyond a certain tolerance level from the course intended by the driver. Which means, that as rule, first the engine drive torque is reduced. If this is not enough, brake pressure is generated at one wheel by the ESP® hydraulics unit. The resulting, one sided braking torque causes a yaw moment which brings the vehicle back onto the course intended by the driver within the scope of physics (see fig. 2).

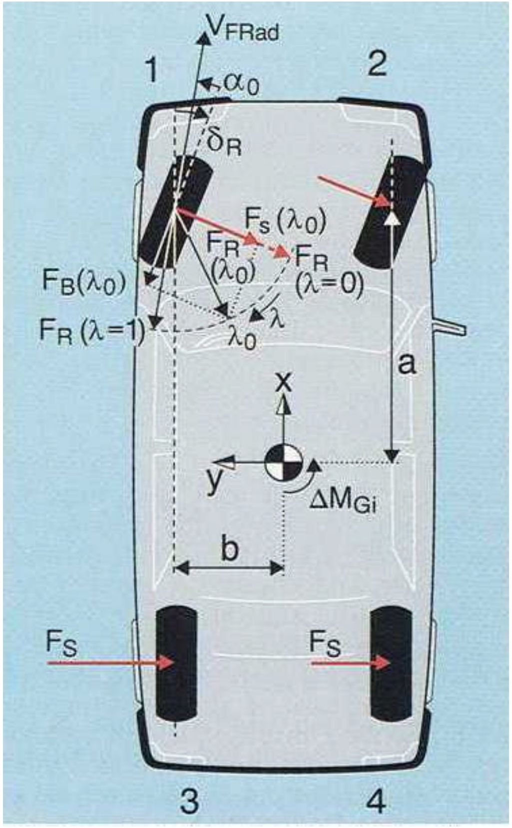


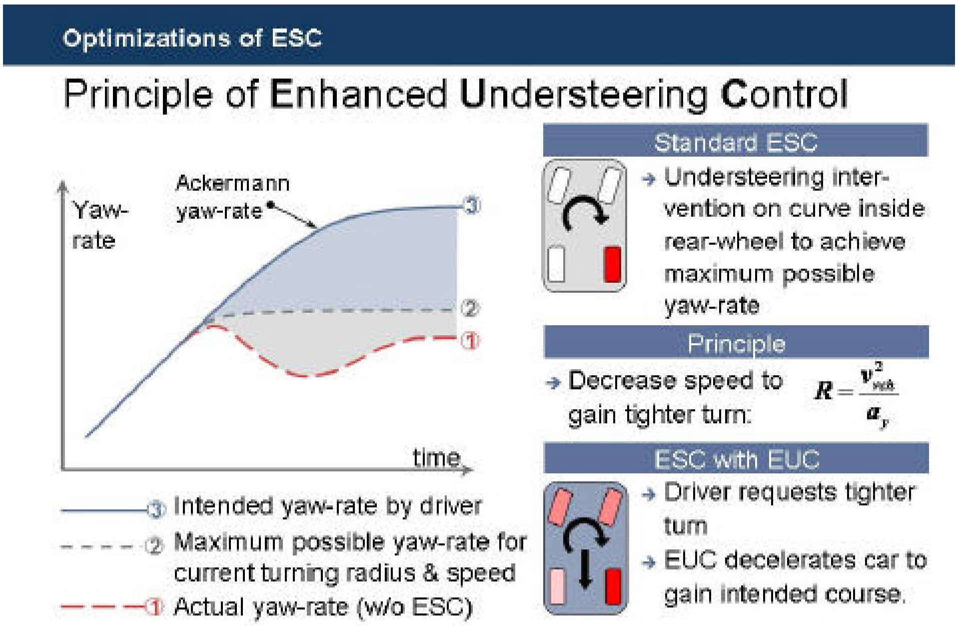
Fig.2: Rotation of the resulting forces on wheels (lateral/longitudinal) through specific increase of braking torque at wheels.

Course deviations only occur in critical driving situations. These can be broken into the two categories of "understeering" and "oversteering. Oversteering, also commonly referred to as skidding, frequently leads to completely losing control over the car. A study by the German National Federation of Insurance Companies GDV indicated as early as in 1998 that 25 % of all accidents with serious bodily injuries are caused by skidding.

In these situations of oversteering, ESP® intervenes by rapidly building up braking torque at the curve outside front wheel, thus stabilizing the vehicle. A similar braking intervention is also initiated in driving situations which threaten to bring the car into a roll-over situation, and has proven to be especially efficient for cars with a raised center of gravity. In addition to the braking intervention in situations of oversteering or understeering, the drive torque of the engine is equally adjusted.

In situations of understeering, during which the vehicle is pushesd to the outside of the curve over its front wheels, ESP® builds up braking torque on the curve inside rear wheel. This practically pulls the vehicle back into the curve. Should the driver insist on tightening the radius of the curve even further, this will finally result in reducing the vehicle's speed (see fig. 3).

Fig.3: Principle of enhanced understeering control



Most drivers react to such emergency situations by turning the steering wheel even more into the curve, which, however, cannot yield any better driving dynamics. The error is equalized by the Bosch ESP® system with the function "Enhanced Understeering Control". The standard understeering intervention is overridden at all four wheels by a braking torque which reduces the vehicle speed to the extent that the curve radius requested by the driver can be achieved (see fig. 4). Normally, the vehicle would have shot off the road in such a situation, now accidents can be prevented.

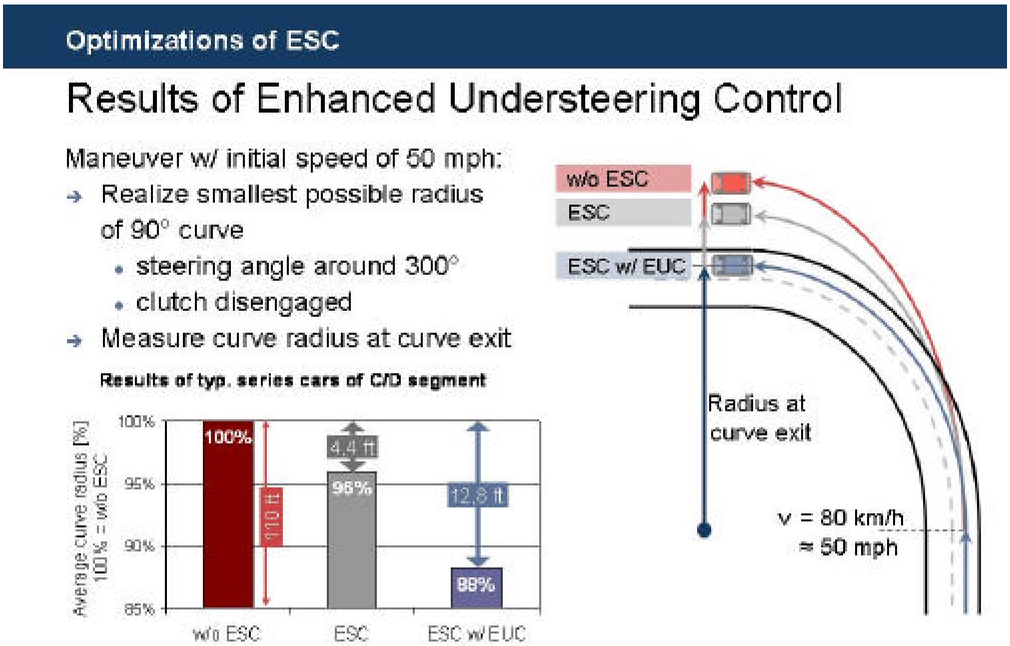


Fig.4: Improvement generated by "Enhanced Understeering Control" in mid-range cars.

Improving Road Safety

Accident research has shown that many types of accidents occur with similar relevance all over the world. Loss of control over the vehicle due to skidding leads to single-car accidents with lateral collision, such as with posts and trees. The risk study by the GDV for Germany indicates that 60% of all fatal accidents by single cars are lateral collisions, caused mainly by skidding. Since ESP® effectively prevents skidding, there were very early high expectations of a confirmed, positive impact on road safety. In the meantime, many studies from all over the world indeed provide evidence, produced by a variety of methods, of the major positive effect of ESP® (see fig. 5).

Fig.5: Selected studies on the effectiveness of ESP® on road safety.

DaimlerChrysler produced evidence that the share of Mercedes-Benz passenger cars involved in driving accidents went down by some 40% since the launch of ESP® as standard equipment in Mercedes cars.

Toyota conducted a comparative study in the Japanese market. Three models, partially equipped with ESP®, were investigated to find the share of vehicles with and without ESP® involved in severe driver accidents. The result was that the same vehicle models with ESP® were about 50% less frequently involved in severe accidents than those without the system.

A study from Sweden in 2002 showed that vehicles equipped with ESP® were overall 22% less frequently involved in accidents. This included all accidents registered by the police independent of their severity.

No matter what the methodological design of the study, they all arrive at similar conclusions: the more severe the type of accidents observed, the more positive the effect of ESP® on road safety.

Even though many mid-range cars in Europe are offered with ESP® as standard equipment, the installation rate for all new cars all over Europe in 2004 reached only some 37%. Thus the relatively small share in the total vehicle fleet indicates the immense potential for improvement in road safety which could be realized by a wider employment of ESP® .

The slogan should be **"No car without ESP®".**

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Putting Pedestrian Safety in the Driving Seat

Every year in the European Union there are over 9,000 deaths and 200,000 injured victims in road accidents in which pedestrians and cyclist collide with a car. Hoping to improve on these grim statistics is a cutting edge system that could ultimately help to save the lives of vulnerable road users (VRUs). The concept is relatively straightforward, explains Dr Marc-Michael Meinecke of Volkswagen, which is one of the chief partners in the IST-sponsored SAVE-U project along with other key industry players such as Daimler Chrysler, MIRA and Siemens VDO Automotive. "SAVE-U combines sensors such as radar, vision and infra-red camera, as well as senor fusion and actuators to increase safety for pedestrians. The main idea is that the sensors will recognize pedestrians and if the pedestrian has a high probability to collide with the vehicle then automatic braking will be initiated by the system," he says.

For further information contact Dr Marc-Michael Meinecke, Pre-Crash Sensing/Pedestrian Recognition, Volkswagen AG. E-mail: Marc-Michael.Meinecke@volkswagen.de.

(Source: Information Society Technologies. http://istresults.cordis.lu) - for this and other similar interesting topics.

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Dates For Your Diary

International Bodyshop Industry Symposium (IBIS) is to be held in Montreux, Switzerland, 31 May—2 June 2006.
Details: www.ibisworldwide.com

Crash Test Expo Europe 2006 is to be held in Stuttgart, Germany, 9-11 May 2006.
Details: www.crashtest-expo.com

50th Annual Conference of the Association for the Advancement of Automotive Medicine (AAAM) is to be held in Chicago, Illinois, 15-18 October 2006.
Details: www.carcrash.org

Annual RCAR Conference 20006 is to be held in Tokyo, Japan 22-28 October 2006, and will be hosted by The Jiken Centre.

NACE 2006 is to be held in Las Vegas, Nevada, 2-4 November 2006.
Details: www.naceexpo.com

50th STAPP Car Crash Conference is to be held in Dearborn, Michigan, 6-8 November 2006 Details: www.stapp.org

SAE 2007 World Congress is to be held in Detroit, Michigan, 16-20 April 2007.
Details: www.sae.org

From The Secretary General

Welcome to the March 2006 edition of the RCAR Newsletter. This issue contains news from thirteen of our twenty-six centres. Pride of place on the front page is given to IAG Australia who opened their new centre this month. This seems to me to be a very bold statement, if one were needed, of the importance of our RCAR Members' work in influencing safety and the economic aspects of motoring. We congratulate IAG on the opening of their new research facility. However other very important work is being undertaken elsewhere in Asia, North and South America, and in Europe. I am grateful for centres in these regions for sharing their progress with us in this issue.

I also welcome two new European heads of centre into the RCAR Community: Vincent Claeys has taken over Cesvi France from Jean-Denis Gosselin and Frank Leimbach has taken over from Klaus-Dieter Moser at KTI, Germany. We hope that they both settle in and enjoy their work and we look forward to meeting them in October at the RCAR meeting in Japan.

In respect of the October meeting, I have started the planning process with our colleagues in JKC and I am sure Mr Minoru Suzuki and his team will host a memorable RCAR Conference later this year.

I noted with interest that Thatcham have organised a two-day symposium on Electronic Stability Control (ESC) which I look forward to attending. This very important issue is covered in a technical article in this newsletter. I am indebted to Hartmuth Wolff of AZT for liaising with Robert Bosch GmbH. Drs Liebemann and Schroeder of the Chassis Systems Control Department of Robert Bosch have produced an excellent article, for which I am most grateful.

In the UK we are just emerging from our winter and I know a number of northern hemisphere centres have had a harsh winter, Japan and Korea in particular, and some of you may find the pictures of the Korean centre, KART, under snow of interest.

I look forward to seeing most of you later in the year.

With best wishes,

Michael Smith

The RCAR Network

Of the 26 RCAR Centres in 19 countries, all have web sites. Addresses are to be found on www.rcar.org.
For convenience, web sites are also listed below.

AZT Germany	www.allianz-azt.de	KTI Germany	www.k-t-i.de
Centro Zaragoza Spain	www.centro-zaragoza.com	Lansforsakringar Sweden	www.lansforsakringar.se
Cesvimap Spain	www.cesvimap.com	MPI Camada	www.mpi.mb.ca
Cesvi Argentina	www.cesvi.com.ar	JKC Japan	www.jikencenter.co.jp
Cesvi Brasil	www.cesvibrasil.com.br	KART Korea	www.kidi.co.kr
Cesvi Colombia	www.cesvicolombia.com	MRC Malaysia	www.e-mrc.com.my
Cesvi France	www.cesvifrance.fr	FNH Norway	www.fnh.no
Cesvi Mexico	www.cesvimexico.com.mx	IAG Australia	www.nrma.com.au
CESTAR Italy	www.cestar.it	State Farm USA	www.statefarm.com
VAT Finland	www.liikennevakuutuskeskus.fi	Tech-Cor USA	www.tech-cor.com
Folksam Auto Sweden	www.folksamauto.com	Thatcham UK	www.thatcham.org
ICBC Canada	www.icbc.com	VIC/IBC Canada	www.vicc.com
IIHS USA	www.highwaysafety.org	Winterthur Switzerland	www.winterthur.com